AMAZONIANA XVI (3/4): 363-395 Kiel, Dezember 2001

Amazonia 2000: An evaluation of three decades of regional planning and development programmes in the Brazilian Amazon region

by

G. Kohlhepp[1,2]

Prof. Dr. Gerd Kohlhepp, Geographisches Institut, Universität Tübingen, Hölderlinstr. 12, 72074 Tübingen, Germany.
(Accepted for publication: September, 2001).

Abstract

During the last three decades the planning region "Amazônia Legal" with 5 million km^2, the world's largest area of tropical forests, endured six phases of regional development programmes with far-reaching state and private activities: 1) National Integration, 2) Polamazônia, 3) Integrated rural development, 4) Grande Carajás, 5) Strategies of sustainable development in the Pilot Programme, 6) Avança Brasil.

Consequence of all regional development programmes, with the exception of the Pilot Programme, has been an increasing destruction of tropical forests, comprising 14 % of the total forest area. The new Avança Brasil Mega-Programme, financed mostly by the government, with enormous expansion of infrastructure and complex economic activities, is provoking large environmental impacts, representing a major challenge for the future development of Amazonia.

After the abolishment of SUDAM because of fraud and corruption, decentralized regional development will have to satisfy the basic needs of the regional population on the basis of sustainable management of forest resources and the preservation of biodiversity in Amazonia.

Key words: **Amazonia, regional development, tropical forests, deforestation, Pilot Programme, Avança Brasil Programme, SUDAM.**

[1]Dedicated to Prof. Dr. Harald Sioli on the occasion of his 90th anniversary.

[2]I would like to express my profound gratitude to Harald Sioli for the permanent dialogue on Amazonian issues since he invited me to a colloquium at the Max-Planck-Institut für Limnologie, Abt. Tropenökologie, in Plön in May 1974. The then lecture was published 25 years ago in Amazoniana **6**(1), 1976.

ISSN 0065-6755/2001/363/

Resumo

A região de planejamento „Amazônia Legal", de 5 milhões de km², sendo a maior área de florestas tropicais do mundo, passou nos últimos 30 anos por seis fases de programas de desenvolvimento regional com ações estatais e privadas: 1) Integração Nacional, 2) Polamazônia, 3) Desenvolvimento rural integrado, 4) Grande Carajás, 5) Estratégias de desenvolvimento sustentável no âmbito do Programa Piloto, 6) Avança Brasil.

Com exceção do Programa Piloto, todos os programas de desenvolvimento levaram a uma crescente destruição das florestas tropicais, significando 14 % da área florestal. O Mega-Programa Avança Brasil, financiado em grande parte pelo Governo, com ampliação da infraestrutura e atividades econômicas reforçadas, provoca grandes impactos ambientais, o que representa grande desafio para o futuro desenvolvimento da Amazônia.

Com extinção da SUDAM por causa de fraude e corrupção, o desenvolvimento regional decentralizado deverá satisfazer as condições de vida da população regional, tendo como base o manejo sustentável dos recursos e a preservação da biodiversidade da Amazônia.

Introduction

In 1966, a new phase began in the Brazilian federal government's development programmes and the economic exploitation of the Amazon region. Regional development planning shifted to the spatially relatively isolated North of the country. A regional planning authority for the Amazon region, the "Superintendência do Desenvolvimento da Amazônia (SUDAM)", was re-established after the mainly abortive attempts of its predecessor SPVEA, in order to implement the military government's specific economic targets set out in its growth-orientated development model.[3] The new planning region "Amazônia Legal" with about 5 million km² covers the rain forests of the Amazonian lowlands and the northern slopes of Central Brazil, a region accounting for 59 % of the total area of Brazil. The "Amazon operation", organized like a military exercise, mobilized mainly public and private funds in Brazil. It was intended to demonstrate the ability of the new political system to push ahead the development of a leading Third World power by new strategies to exploit its economic potential (KOHLHEPP 1978), even in regions with "adverse" natural conditions and serious logistic problems.

The rapidly increasing social tensions in the Brazilian Nordeste which were caused by neglecting the urgently needed agrarian reform and became even greater after a disastrous drought, led in 1970 to a strategic geopolitical arrangement, combining the infrastructure and economic exploitation programmes in Amazonia with an agrarian colonization project for resettlement of landless Nordestinos. The Amazon region was seen as a spatial outlet to the unsolved social conflicts. New land in Amazonia was offered as a so-called alternative of an agrarian reform (KOHLHEPP 1979).

Measures for regional economic development in Amazonia can be subdivided in two categories:

1. *State action* for developing the infrastructure concentrated on road transport as main part of the efforts to integrate Amazonia. Selected agrarian colonization projects were implemented. Corporation tax reduction was one of the most important factors of attracting private investors in state-approved development projects.
2. *Private action* was based on investments in every economic sector by means of financial incentives through tax reduction to be employed as investment capital, mainly in cattle-breeding, industrial and mining projects.

[3] SUDAM was abolished in May 2001 because of corruption and fraud of enormous dimensions (see: "Perspectives" in this paper).

Phases of regional "development" in Amazonia

Regional development planning for the Amazon region over the last 30 years may be divided into six main phases:

The Programme of National Integration (PIN) in the first half of the 1970s

The infrastructural development programme was based on the planning concept of development axes and achieved by the construction of numerous long-distance highways, such as the Transamazônica and the Perimetral Norte, both east-west axes, and Cuiabá-Santarém as well as Cuiabá - Porto Velho - Manaus (see Fig. 1). The pioneer roads were guidelines for migration into Amazonia and were planned to produce areas of economic activity in the form of so-called development corridors, but their construction caused severe environmental impacts (GOODLAND & IRWIN 1975). The legal bases were provided for establishing 200 km-wide corridors for state colonization. According to the INCRA model of this large-scale settlement operation, mainly for farm workers and share-croppers from the Northeast, a 10 km-wide strip on both sides of the roads across Amazonia was to be reserved for small holdings - 100 ha each in a land-rotation system with only 50 % to be cleared - and the remainder was allocated for units of up to 3,000 ha. Unfortunately the plan to remove 2.2 million km² of land from speculation by expropriation along all the trunk roads was not realized. This would have strengthened federal and regional state activities to conserve large tracts of rain forests decades later.

Because of the low fertility of the *terra firme* soils with their deficiency in inorganic nutrients and inadequate exchange capacity of cations (FEARNSIDE 1986; KOHLHEPP & SCHRADER 1987), the idealistic model of colonization had to be concentrated on selected sub-areas. State prototype projects were implemented along the Transamazônica between Rio Xingú and Rio Tapajós (MORAN 1981; SMITH 1982) and in Rondônia on the Cuiabá - Porto Velho road.

The number of officially settled colonists was only a fraction of the initially extremely optimistic objectives. After referring to 1 million settler families in the beginning, INCRA reducing this later to 100,000, up to the mid 70s only 7 % of the planned number have settled on the Transamazônica (KOHLHEPP 1976b). Since 1973 the focal point for state-controlled colonization has been switched to Rondônia (KOHLHEPP & COY 1986; COY 1988).

The agrarian colonization, especially along the Transamazônica, was a failure, because the ecological conditions were not properly understood and therefore the sustainability was assessed in a far too positive manner (MAHAR 1988). Planning, land survey, organization, advice to the settlers, land-use models (rapid switch to permanent crops) and marketing facilities were inadequate. Even the concept of *agrovila* central

settlements failed.

Nevertheless, the government's slogan "There is land for everyone in Amazonia" sparked a mass migration to the north, which started spontaneously in the second half of the 70s. The agricultural frontier rapidly advanced along several pioneer fronts, stretching deep into the tropical rain forests (KOHLHEPP 1983).

The Polamazônia Programme from 1974 to 1980

At the height of the Brazilian "economic miracle" period the prevailing El Dorado-mentality involved the sectoral economic exploitation and the nearly unlimited territorial distribution of the Amazonian periphery. The operational scope allowed for private business activities was greatly increased and became the new focal point of the development strategy. The offical explanation for this far-reaching decision was the first oil price crisis, forcing the government to cut back in its investments due to the serious financial consequences of expensive oil imports.

In this second phase the regional planning strategies in Amazonia have been concentrated on the growth pole concept which has been discussed in Latin America since the mid 60s. The poles of development provided for in the Second National Development Plan (1975-79) are based on separate sectoral focal points, e.g. mining of mineral resources or areas for cattle-breeding with possible industrial processing.

National and international capital investors were attracted by extremely favourable tax reduction incentives and also by many other benefits. It became advantageous for banks, insurance companies, real estate firms, mining, transport or road construction companies and industries to invest in the clearing of tropical rain forests in order to install large cattle-breeding projects with the financial assistance of official subsidies and exploiting the extremely low land prices. The traditional Brazilian cattle ranchers operated largely as subcontractors. The cattle farms - the official maximum land area has been 60,000 ha, in reality Volkswagen do Brasil (140,000 ha) or the multi-national Liquigas Group (566,000 ha) and others created large estates - have been responsible for the largest amount of destruction of the rain forests, mainly in the south-eastern and eastern region of the State of Pará and the northern part of Mato Grosso (KOHLHEPP 1984, Fig. 3). During the mid 80s, the officially approved cattle farm projects controlled almost 9 million hectares. From a total of 350,000 km^2 of land acquired by cattle farms, mostly forest areas of about 140,000 km^2 were cleared (KOHLHEPP 1987a).

The rapid expansion of deforestation by fire clearing in ranching projects has caused irreversible damage to the forest ecosystems, such as erosion, eluviation of nutrients, surface crusting and disturbance of water balance. Furthermore, land speculation has caused serious problems and violent conflicts with the indigenous and the *posseiro* population. Because of rapid pasture degradation cattle farming turned out to be an economically unprofitable activity and after a few years livestock herds declined severely. The withdrawal of tax incentives some years later contributed to the end of new cattle ranching initiatives.

The exploitation of mineral resources was one of the main goals of Amazonian development programmes. Many prospecting licenses for large tracts have been issued to national and foreign firms (see Fig. 1). After manganese and tin ore deposits in Amapá and Rondônia have been mined since the mid 50s and 60s, the newly discovered enormous iron ore deposits in the Serra dos Carajás and bauxite on the Rio Trombetas as well as gold and diamond deposits proved Amazonia's wealth of mineral resources

and in the 80s started new major projects in the region.

In the Polamazônia Programme the growth pole concept was misinterpreted and the result was not a "decentralized concentration" of development but the widening of the inter- and intraregional development gap. The periphery became even more dependent on the centre at the national as well as the international level. Instead of growth poles with radiating development impulses enclaves appeared, artificially maintained (KOHLHEPP 1997). Conservative modernization "from above" by the military governments, incorporating the private sector with the regional and national elites by financial incentives, had to keep up the democratic appearance, in order not to endanger international creditworthiness.

The military administration saw its leading role as that of the only protagonist capable of realizing modernization through rational planning (BECKER & EGLER 1992), the regional component often being treated in a superficial manner.

Integrated rural development programme, dating from the early 1980s

The failure of the cattle ranching projects becoming obvious at the end of the 70s, gave a strong impulse to new ideas of agrarian colonization by small-scale farmers. The Polonoroeste Programme in Rondônia and northwestern Mato Grosso, financed by the World Bank, created a new concept for a poverty-oriented integrated development for rural areas in a pioneer zone, based on three premises:

- Rural lower social classes as target groups
- Development of strategies for satisfying basic needs
- Encouragement of a participative approach.

Existing colonization projects ought to be consolidated and new state-directed integrated projects were established. By 1985 more than 44,000 families had been settled (KOHLHEPP 1987a; COY 1988). The "development from below" approach was strengthened and numerous innovations in planning, organization of settlement and improvements in the production and marketing of agricultural goods were realized. An enormous wave of spontaneous migration from the socially deteriorating southern and southwestern rural areas, also from the conflicting urban sphere, was attracted by land distribution in the rapidly exhausted colonization projects. This caused a major upsurge in the amount of land seized and uncontrolled settling in areas with very limited agricultural carrying capacity continued. Large areas of forest were cleared and in many cases settlers were displaced by land speculators and cattle farmers. As deficiencies and problems increased in the optimistically announced Polonoroeste Programme, the succeeding Planafloro Programme was installed some years later, in order to reorganize the socially and ecologically problematic situation in Rondônia.

Mega-programmes and projects of the 1980s

At the same time when participation was propagated in integrated rural development as a new model in Rondônia, major projects realized in the east of Amazônia Legal practised old-style "development from above". Information for the regional population affected by such projects has been insufficient and belated. Decisions were made without any coordination with the respective regional or local authorities (VALVERDE 1989). Not even the executive authority for regional development in Amazonia, SUDAM, participated in decision-making of the largest regional development programme "Grande Carajás" (PGC). This top-down programme covered an area of almost 900,000

km² in eastern Amazonia, in the States of Pará and Maranhão (KOHLHEPP 1987b).It has been running since 1980 and has shown a strong dependence on world market conditions. The goal of the PGC was to establish a number of infrastructural, mining and industrial projects on the basis of highly important mineral deposits in the Serra dos Carajás, especially iron ore.

While the iron ore mining project as the heart of the PGC occupied only a limited area, totally fenced in and very well organized by the then state-owned Cia. Vale do Rio Doce, the associated projects and the uncontrollable spontaneous migration to the planning region led to an almost chaotic situation. Building of highways, the Carajás ore railway, the new deep-water port of Ponta da Madeira near São Luís, the construction of the major power station at Tucuruí (4,000 MW), damming up the Rio Tocantins and forming a 2,430 km² reservoir, the widely branching transmission line system and the giant aluminium smelters at Barcarena near Belém and at São Luís contributed to the superimposing of new spatial structures, a new surge of deforestation, associated with charcoal production, increasing intra-regional socio-economic disparities and regional disintegration (HALL 1989; VALVERDE 1989).

Lack of regional and local participation in all sectors and the so-called integration into the world market intensified the "periphery of periphery syndrome" for the Grande Carajás planning region. Numerous conflicts of interest, failure to respect the boundaries of indigenous reservations, hazardous insecurity as regards legal rights and continuous escalation of competition for land use led to a situation, in which the co-existence of the competing social groups and their economic objectives underlined the lack of common development goals for the Amazon region. Economic growth with major projects had to pay a high price with rain forest destruction and ecological and social regional degradation.

A new approach to sustainable regional development: The Pilot Programme starting in the 1990s.

The change in development strategies to an environmentally sound concept was one of the basic guidelines of a hopefully announced new regional policy for Amazonia, after ecological and social disorder having prevailed in some Amazon regions over the past three decades. The institution of the National Environment Secretariat (SEMAM) in 1993 raised to the status of Environment Ministry.

As a result of the international concern about deforestation of tropical rainforests the "International Pilot Programme to Conserve the Brazilian Rain Forests" (PPG-7) was created by a German initiative at the Houston summit of the G-7 countries in July 1990 (KOHLHEPP 1995). The G-7's proposal to financially support the Brazilian reorganization of regional development models for Amazonia was accepted by Brazilian authorities. In spite of all counteracting nationalistic activities in Brazil questioning national sovereignty in the Amazon region and the resistance of economic lobbies against an environmental programme, the PPG-7 was approved, just on the eve of the 1992 Rio UNCED summit. The G-7 countries renewed their commitment to provide financial support by donations of initially about US$ 290 million and technical assistance. The World Bank was commissioned to coordinate the programme and a Rain Forest Trust Fund with US$ 60 million was established under World Bank trusteeship.

The PPG-7 is a joint undertaking of the Brazilian government, Brazil's civil society and the G-7 community as donor to substantially reduce the deforestation rate. The

programme consists of a set of projects that should contribute to the sustainable use of natural resources. The overall objective is "to maximize the environmental benefits of the forests in a way that is consistent with Brazil's development goals" (WORLD BANK 1994).

The regional development policies of the World Bank have changed considerably in the last decades. The environmental concept, in addition to the social relevance of projects, became predominant during the 1980s, and just before the beginning of the next decade, the new paradigm of sustainable development prevailed.

According to the PPG-7 objectives, a model of North-South cooperation on global environmental issues could be provided, trying to prove the possibility of harmonizing economic and ecological objectives in tropical rain forests (MMA/WORLD BANK 1998; KOLK 1998). It could help to preserve biodiversity and the immense genetic resources, as well as to reduce Brazilian carbon emissions by reducing the deforestation rate (WORLD BANK 1994).

The Programme pursues five main lines of action:

- *Experimentation and demonstration* to promote practical experience by local communities in conservation, sustainable development and environmental education initiatives. This is realized through Demonstration projects, Forest and Floodplain Resources Management (JUNK et al. 2000), Fire Prevention and Training projects (NEPSTAD et al. 1999). The floodplains *(várzeas)* of white water rivers enable a multiple use of natural resources (SIOLI 1956, 1969, 1984; STERNBERG 1956/1998; WILHELMY 1970; JUNK 1989).

The Demonstration Projects started in 1995 and are key elements in the PPG-7. They aim to test and disseminate community-based conservation and small-scale development initiatives that are environmentally, economically and socially sound and will bring a direct benefit to the local population living in the rain forests. Up to now 140 projects have been realized. Many of the projects experiment with new forms of sustainable resource use, including the processing and marketing of non-timber forest products, such as fruits, resins or nuts. Restoring of degraded lands by introducing agroforestry systems is another core project (SMITH et al. 1998). A network of NGOs (HALL 1997) is supported, trying to disseminate best practices.

- *Conservation* by improvement in managing protected areas, such as parks and other nature reserves, national forests, extractive reserves (CLÜSENER-GODT & SACHS 1994) and indigenous lands. The concept of rain forest corridors as one of the projects in preparation links protected areas and their buffer zones in networks.

Conservation policies in Amazonia are confronted with a series of problems in allocating scarce resources, but new legislation was introduced in the year 2000 creating a broad range of conservation options within the National System of Conservation Units (SNUC). The contribution of the Pilot Programme to the setting up of a new conservation policy is significant (IAG 2001).

The demarcation and registration of indigenous reserves is one of the most urgent but politically controversial tasks (KASBURG & GRAMKOW 1999). As the spatial, physical and cultural integrity of the indigenous groups is threatened, their lands must be protected (KOHLHEPP 1998a). Indigenous people have long used the Amazon rain forest ecosystems without causing environmental degradation. Their specialized knowledge of natural resources is considered fundamental for the sustainable use and management of forest resources.

The Indigenous Lands Project, mainly financed by Germany, aims at promoting the conservation of their natural resources by completing the legalization and the protection of 121 indigenous areas in Amazonia (see Fig. 8).

- *Institutional strengthening* to enable the nine Amazon state governments and public institutions to enforce sound environmental policies, in cooperation with the private sector and the civil society, within the framework of environmental decentralisation and the related capacity-building. This is supported through the complex Natural Resources Policy Project (KOHLHEPP 1995, 1998c) - involving land-use zoning as policy instrument for land management (MAHAR & DUCROT 1998; MAHAR 2000) - and the Fire and Deforestation Control Project.

- *Scientific research* to improve scientific knowledge about Amazon ecosystems and the sustainable use and management of their resources. One component, the Science Centres Project, gives support to modernize two well-known institutions, the INPA (Instituto Nacional de Pesquisas da Amazônia, Manaus) and the Museu Paraense Emílio Goeldi in Belém, in order to substantially improve the regional research basis and to help recruiting and retaining researchers of a high level. The "directed research" component enables highly qualified scientists to apply for funding of projects with specific research priority.

- *Dissemination of lessons learned* to make knowledge gained and results widely available. This will be done through the Monitoring and Analysis Project.

The Pilot Programme is an extremely complex initiative and its experimental nature gives an exemplary stimulus to a learning process in sustainable development at the level of international, national, regional and local actors (BECKER 2001). It encourages public-private partnerships and the creation of strong NGO networks as well as the participation of local communities in decision-making in strategies of resource use and management. Financed by donor countries, the main donor being Germany with 45 % of the total costs, the Pilot Programme - in spite of all deficits or conceptual, organizational and implementation obstacles - is up to now the most successful example of an international environmental cooperation programme (KOHLHEPP 1998c). It is a challenge for the Brazilian government to prove that the commitment to a new model of sustainable regional development could be realized in the Amazon region.

Before turning to the most recent phase of the regional development strategies for the Brazilian Amazon region, an excursus analyzing the current situation and some specific problems is necessary.

Case studies of current problems in Amazonia

Population distribution and increase in urbanization

The Pilot Programme covers the planning region Amazônia Legal with today about 20 million people, two thirds living in urban settlements. From this point of view, Amazonia is "an urbanized forest" (BECKER 1995) with "rainforest cities" (BROWDER & GODFREY 1997). Besides the two outstanding regional metropolis Manaus and Belém, cities of over one million inhabitants, São Luís and the booming Mato Grosso capital of Cuiabá are important urban centres. The traditional spatial organization of the location of urban settlements along the Rio Solimões-Amazonas and some main tributaries is complemented today by population concentration in cities and rural surroundings

along the development axes, e.g. in Rondônia, along the Transamazônica in Pará and along the Belém-Brasília highway (see Fig. 2). Because of the extensive migration, frontiers advance rapidly and cities concentrate efforts to reorganize urbanization and to establish new urban development models with a sustainable social and ecological basis (COY 1992). The number of indigenous people in Brazilian Amazonia is about 300,000 today, living mostly in 556 areas, recognized by Brazil's National Indian Foundation (FUNAI) (see Fig. 8).

Deforestation

Up to the present time, the destruction of tropical rain forests in Amazonia was caused by agrarian colonization with about 50 % of deforestation, cattle ranching and agrobusiness (45 %) and industrial projects, timber industry, mining (including *garimpeiro* activities), electrical power plant reservoirs, urban sprawl, infrastructural projects with 5 %.

According to recent studies of the Brazilian Space Research Institute (INPE 1998, 2000) analyzing satellite imagery to quantify deforestation, the total area of tropical rain forests cleared in the Amazon Region was 552,000 km^2 in 1998 and may have increased to 580,000 km^2 in 2000. This amounts to 13,5 % (1998) of the natural rain forest area in Amazônia Legal, calculated by SKOLE & TUCKER (1993) as 4.093 million km^2. Until 1975 only 0.6 % had been cleared. From this year onwards, government development strategies and related impacts of human activities increased rapidly the deforestation rate (see Table 1 and Fig. 3) and caused enormous impacts (FEARNSIDE 1993, 1999b, 2000; MMA 2001).

By 1978 3.7 % of the forest vegetation had disappeared, by 1988 the percentage augmented to 9.2 %. Regional disparities of forest clearing are extremely high. While in the State of Amazonas no more than 1.9 % have been deforested, the exploitation pressure in Rondônia and Mato Grosso runs up to 25 % of the natural rain forest area. Pará, with a deforested area of nearly 190,000 km^2, has the highest absolute deforestation figures, followed by Mato Grosso. Tocantins (87 %) and Maranhão (69 %), states with considerable *campos cerrados* areas, show the highest rate of deforestation. The enormous absolute increase of deforestation in Pará, Maranhão, Mato Grosso and Rondônia in the last 25 years is seen in Fig. 3. The mean rate of gross deforestation in Brazilian Amazonia between 1978 and 1988 was about 21,000 km^2, in the period 1988-1998 16,400 km^2 (INPE 2000). Preliminary deforestation data from August 1999 to August 2000 unfortunately amount to 19,800 km^2, concentrating on Mato Grosso (40 %) and Pará (30 %) (Veja, May 23, 2001).

The forest area affected by human activities each year is much larger than the figures shown in the INPE deforestation monitoring programme. This is caused by forest surface fires, getting out of control and expanding into primary forests. They can destroy from 10 to 80 % of the aboveground biomass, but are hardly to be detected by satellite images. The surface fires may affect the double area of deforestation and even larger areas in years of severe drought (NEPSTAD et al. 1999).

Logging activities

In the year 1997, production of timber in logs in the Amazon region amounted to 28 million m^3; 75 % were extracted in Pará and Mato Grosso. Timber export to foreign markets accounts for only 14.4 % of the total volume, while 56.1 % of the consumption of Amazon timber is concentrated in the Southeast and South of Brazil (SMERALDI & VERÍSSIMO 1999). The contribution of timber from Amazonia to Brazil's overall wood production has rapidly increased from 14 to 85 % in just two decades. With the destruction of Southeast Asian tropical forests, the Amazon region is targeted by transnational corporations to be the key resource area for tropical timber in the future (COTTON & ROMINE 1999). Asian, in particular Malaysian companies are entering in an aggressive manner and try to get concessions for large-scale logging (GREENPEACE 1997).

Illegal timber extraction is increasing (AMIGOS DA TERRA 1997) and logging crews severely damage 10,000 to 15,000 km^2 of forest per year that are not included in deforestation statistics (NEPSTAD et al. 1999). As logging is spreading across large parts of the Amazon region in an unregulated fashion, zoning of timber extraction has to be organized according to ecological criteria and protection from logging in specific areas must be strictly controlled (VERÍSSIMO et al. 1998)

After the failure of government initiatives to diminish predatory forms of forest exploitation, forestry certification based on environmental and social standards emerged in 1997 promoting sustainable forest management. Among the certification initiatives, the Forest Stewardship Council (FSC) gained significant recognition. Today only a small number of companies have received the FSC seal of certification in Brazil. Only one is an Amazon timber producer: the Swiss-owned Cia. Mil Madeireiras in the State of Amazonas, operating with management of natural forests (SMERALDI & VERÍSSIMO 1999). The demand for certification will depend on the awareness of the final timber consumer and the international trading and market regulations.

El Niño events and fires in Amazonian rain forests

El Niño events have been known during the past 2000 years in Amazonia (MEGGERS 1994), but became more frequent in the last two decades. They are associated with long drought periods, which affect huge areas of Amazonia. Moreover, rainfall reductions are a result of deforestation in the Amazon region (NOBRE et al. 1991). This will - together with selected logging - increase the flammability of intact tropical rain forests, which in years of average precipitation are hardly vulnerable to burning.

During the severe drought from July/August 1997 to April/May 1998 rainfall reduction in locations far away from each other caused an enormous deficit in precipitation, compared with the cumulative amount of rainfall in "average" years (NEPSTAD et al. 1999). Fig. 4 shows the nine months' rainfall deficit, ranging from 500 mm in Belém and 900 mm in Marabá to 1,200 mm in Belterra on the Rio Tapajós in Central Amazonia.

The concentration of fires along the southern and eastern parts of Amazônia Legal, as photographed by the NOAA satellite in 1998, gives an idea of the magnitude of burning in large sub-regions of Amazonia (Fig. 5). The "arc of deforestation" is extending from Rondônia, via Northern Mato Grosso, Southeastern Pará to Maranhão, causing huge emissions of CO_2 (FEARNSIDE 1997) as well as large-scale impoverishment of Amazon forests (NEPSTAD et al. 1999).

Table 1: Deforestation in the Brazilian planning region Amazônia Legal (% of the natural rainforest area).

Amazon States	Natural rain forest area[1] (1000 km^2)	Percentage of state area	Deforestation[2] (in %) 1975	1978	1988	1990	1995	1998 (%)	1998 (km^2)
Pará	1,183.6	93.8	0.7	4.5	11.1	12.2	14.3	15.9	188,372
Amazonas	1,531,1	97.2	0.05	0.1	1.3	1.4	1.7	1.9	28,866
Amapá	137.4	98.4	0.1	0.1	0.6	0.9	1.3	1.4	1,962
Roraima	172.4	76.4	?	0.1	1.6	2.2	3.0	3.4	5,791
Maranhão	145.8	55.7	?	43.8	62.3	64.1	67.1	69.0	100,590
Tocantins	30.3	10.9	?	10.6	71.2	75.5	82.9	87.1	26,404
Mato Grosso	527.6	58.6	1.1	3.8	13.6	15.8	21.3	25.0	131,808
Rondônia	212.2	89.1	0.3	2.0	14.1	15.8	21.7	25.1	53,275
Acre	152.4	99.7	0.8	1.6	5.8	6.8	8.7	9.7	14,714
Amazônia Legal	4,092.8	81.3	0.6	3.7	9.2	10.1	12.1	13.5	551,782

[1] Data after: SKOLE & TUCKER 1993, Table 2, p. 1906.

[2] Data after: INPE 2000 (absolute data of deforestation); author's own calculation of percentage of natural rainforest area.
Data: 1978 (January), 1988 (April), 1990 ff. (August).

The situation of Roraima

But there exist fire events in other areas of Amazonia, such as the case of Roraima. After a nine months drought, in the first quarter of 1998 extensive fires in the northernmost state of Amazonia had catastrophic consequences. Fires for pasture preparation in the *campos cerrados* areas and deforestation fires to clear-cut primary forest by slash and burn agriculture escaped to standing forests, dried by the El Niño phenomenon. A fire frontline of 115 km extension at the end of March 1998 even threatened dense rain forests near the Yanomami reserve. In Roraima an area of 33,000 km^2 was destroyed by fires, nearly 10,000 km^2 being rain forest (Fig. 6; KOHLHEPP 1998c). Roraima declared a state of emergency. National and international relief campaigns had to take care of the existing problems.

As a consequence of this catastrophe, measures to reduce the occurrence of accidental fires and techniques to combat them were introduced, including training programmes.

The vulnerability of Amazonian rain forests with regard to fires favoured by El Niño droughts is highly increasing. According to a fire risk map of Amazonia (IPAM et al. 1998), in the second half of 1998 about 400,000 km^2 of intact rain forests (= 11.5 % of today's forest area in Amazônia Legal) were endangered! 200,000 km^2 are classified as forest areas with a "high risk", among them large tracts of the municipalities of São Félix do Xingu, Marabá, Altamira, Santarém in Pará or Boa Vista in Roraima.

Taking Roraima as an example of decision-making in regional planning and development projects, there exist many levels of conflicts regarding land issues. The main conflict between Federal versus State government concerns public land *(terras devolutas)*. Roraima, like other Amazonian states, claims these lands to be transferred to the regional government. Roraima has been a Federal Territory until 1988. The present-day state government only has jurisdiction over 48 % of its own state's area, indigenous lands under FUNAI tutelage representing 45 % (see Fig. 7).

Conflicts of large landholders and state government versus indigenous tribes are prevailing, as cattle ranches and irrigated rice plantations, existing like enclaves within indigenous lands, ought to be removed from the indian point of view.

Land conflicts between large landholders and poor settlers are barriers to implanting sustainable regional development projects or environmentally sound production systems with small farmers (IAG 2000).

As *garimpeiros* had to leave gold-mining areas on Yanomami land in the early 1990s after severe conflicts with indigenous groups and military intervention (KOHLHEPP 1998a), the number of settlers claiming land has increased. INCRA only regularizes previous invasions in a process of distribution of land, based on political rather than social reasons. There is a total lack of technical assistance.

As the deforestation front advances, projects of the PPG-7, like the extractive reserves and indigenous lands, are threatened in their existence and affect the implementation of the programme.

Indigenous lands: Legal situation and challenges

Since the beginning of the 20th century, Brazilian law has accorded legal recognition to the rights of the indigenous population to their lands. The Brazilian Constitution of 1988 revitalized the concept of protecting and legalizing indigenous reserves, a process to be finished in five years, but accelerated only by the Pilot Programme (KOHLHEPP 1998a, c). The most serious problems are invasions by timber companies as well as by cattle ranchers and squatters. The resettlement of non-indigenous people is extremely complicated and costly. So, there is an urgent need of legal regularization of indigenous reserves. This ongoing process requires that indigenous lands are formally identified, delimited, demarcated, decreed and registered. New planning concepts of sustainable development revalue traditional forms of livelihood and of locally adapted patterns of resource-use as practised by indigenous societies (PASCA 1998; POSEY 2000).

The total area of indigenous lands is about 82 million hectares, i.e. 16.4 % of Amazônia Legal. When the PPG-7 Indigenous Lands Project (PPTAL) was prepared in 1994/95, only 50 % of the 556 areas had been legalized. The current legal situation is mapped in Fig. 8. In recent years the indigenous population, estimated at least as of 5 million in 1500, increased from the absolute minimum number in the 1980s slowly to about 300,000 in Amazonia today. There are probably 2,000 or more indigenous people living in isolated tribes with no contact with the neo-Brazilian society up to now.

Current demarcation is realized in many cases with the active participation of the indigenous people themselves. This has strengthened their control over their territories and capacity-building of indigenous organisations. Technical assistance from NGOs and support from the German GTZ, under the supervision of FUNAI, helped to realize the demarcation process (KASBURG & GRAMKOW 1999) and to protect the continuously threatened indigenous living space.

One of the few examples of legally secured indigenous areas already decades ago is the Parque Indígena do Xingu, a National Park in Mato Grosso. It contributes to the protection of cultural identity of its populations. Their territory is not only the basis for conservation and sustainable use of natural resources, but a source of genuine indigenous knowledge. In Fig. 9, the conflicting situation between the Indigenous Park and deforestation activities of cattle ranchers east of the Park is obvious, as fires to clear forest land for pastures advance directly to the borders of the Park. Colonization along the Cuiabá-Santarém road (BR-163) is expanding eastwards, using a network of exploitation roads until the Park border.

The current "Avança Brasil" Mega-Programme

Since the installation of the "Pilot Programme to Conserve the Brazilian Rain Forests" (PPG-7) in the beginning of the 90s state activities in the Amazon region developed in a disparate manner. On the one hand government's goals for the next years concentrate on improvement in infrastructure, regional economic growth and market integration. On the other hand, because of PPG-7 there is the commitment to realize sustainable development, protection of the living space of the local and regional population as well as of the environment as objective of the regional policy. The new integrated national policy for the Legal Amazon (MMA/SCA 1995; MMA/CONAMAZ 1998; BNDES 1998) aims at a consolidation for Amazonia and is planning to undertake decisive steps towards a sustainability of resource-use adjusted to the interests and welfare of the Amazonian population by decentralisation measures, and participation of the civil society. This forms a fundamental contrast to the Programme "Brazil in action" (1997-99) and its expansion in the most recent Mega-programme "Avança Brasil", the government's new 2000-2003 Development Programme, with planning perspectives until 2007 (MPBM 1999, MPOG 2000, BNDES 2000). A major potential of conflicts of great regional significance could arise as there are enormous private economic interests involved.

As a step to improve infrastructure planning, "the Brazilian government commissioned a major study of integrated national development regions, identifying and evaluating hundreds of projects that offer the potential to accelerate economic and social development in coming years" (MPBM 1999: 5). Many of these infrastructure projects offer investment opportunities for private companies via privatization, joint ventures and other forms of participation. Specific "development structures for investment" are focussing on regional or sectorial themes. Projects were assessed in groups in order to identify potential synergies and were analyzed within the context of nine major development regions, the socalled "National axes of integration and development". These "development regions" have a certain identity, a distinct "economic vocation" and are part of a long-term geostrategic vision of national development. The projects prioritized represent a potential of US$ 180 billion of total investment in Brazil within the period 2000 until 2007.

The Brazilian government is planning to make large-scale investments in development projects expecially in the Amazon region through the "Avança Brasil" Programme. The Government's goals for the next years include doubling of paved roads, the construction of waterways, ports, railways and hydroelectric power plants.

As to the Amazon region there are four bundles of projects (MPBM 1999):

1. Northern international integration
2. Logistics in the Madeira-Amazonas region
3. Logistics in Central Brazil
4. Hydroelectric generation and transmission lines.

1. The two northern states, Roraima and Amapá, are linked with neighbouring countries by paved highways. This redraws the map for a new geopolitical scenario. Manaus can be reached by trucks from Caracas. Besides a considerable smuggling of timber to Venezuela, the regional trade - the Manaus Free Trade Zone is a major producer of household electronics - is expected to grow. It seems doubtful whether the government's goal to facilitate Amazon eco-tourism will be realistic. The paved road connection from Macapá (Amapá) to Cayenne (French Guyana) will be complemented by a road from Boa Vista (Roraima) to Georgetown (Guyana). In spite of military control over this northern border region, drug traffic ubiquitous in the Amazon region will be imminent also to the Caribbean and Atlantic ports and airports (MACHADO 1996).

The 700 km Venezuela-Brazil transmission line (230 KV) from Gurí to Boa Vista, the first major cross-border energy project in Northern Brazil, completed in 2000, will greatly improve energy supply to Boa Vista.

2. The main objective of infrastructural planning in this group of projects is to allow transport of agricultural production, connecting waterway and road transport systems. The Madeira River Waterway, capable of operating modern barges year-round, was improved with very low costs and is gaining major importance for shipment mainly of soybeans downriver by barge tows of up to 6,000 t to Itacoatiara on the Amazon river, east of Manaus. This new transshipment terminal enables soybean transport to the European market by ocean-going freighters of up to 80,000 GRT, reducing considerably transport time and shipment costs in relation to the grain ports of Paranaguá and Santos in Southern and Southeastern Brazil which are distant up to 2,000 km by road.

Together with the upgrading of the BR-364 highway (Cuiabá - Porto Velho) and part of the BR-163 (Cuiabá - Alta Floresta/Mato Grosso) increasing waterway transport of the production of the rapidly expanding soybean and ranching area of Mato Grosso (KOHLHEPP & BLUMENSCHEIN 2000) is northbound. Today the regional production of soybeans is estimated at 6.5 million t, maize crop at 1.4 million t and a livestock of 18 million head.

The agrobusiness boom is turning Porto Velho, the capital of Rondônia, to a new port centre with 1.6 million t cargo (1998) and a container terminal in construction.

With the improvements of the highway system in Mato Grosso and Rondônia, overland traffic between South Brazil and the Manaus free trade zone is gradually shifting from the Belém - Brasília route to Porto Velho. This enables return freight, such as household electronics, from Manaus to the South and Southeast.

Paving 490 km of the BR-364 in Acre from Sena Madureira to Cruzeiro do Sul - with the futurist plan to reach the Pacific via the overland route - and the reconstruction of the nowadays totally impassable BR-319 stretch from Porto Velho to Manaus are main points of interest in the infrastructure project. The highly questionable re-opening of the road connection to Manaus seems to be unnecessary with regard to the Madeira waterway. Miscellaneous highway improvements are connecting road and river transport also in the case of the Purús river.

It is noteworthy that there are no official plans up to now within "Avança Brasil" to continue paving the Cuiabá - Santarém road (BR-163). But it seems doubtful whether economic and regional pressure groups, especially timber trade companies, will not achieve this goal between the Mato Grosso/Pará border and Santarém.

While it is a positive signal that there are no plans for new highways crossing the Amazonian rain forests, the gas pipeline project from the Rio Urucu natural gas field to Porto Velho (500 km) and from Coari to Manaus (420 km) to supply the planned thermoelectric plants in Porto Velho (330 MW) and Manaus (540 MW) will have an enormous ecological impact.

3. Although the development projects of "Avança Brasil" in Central Brazil are realized outside the planning region Amazônia Legal, the consequences directly and indirectly affect the situation of the southern fringe of Amazonia. As the agricultural expansion on the Planalto Central is still increasing, transport infrastructure to the main national markets and seaports must be improved. The Ferronorte, a railway project of continental dimensions, is planned to link Southwestern and Central Amazonia with the existing rail network running to the coast. Ferronorte, a federal concession, is being funded privately and the first 410 km of the track from the Paraná river in northwestern direction were realized in the end of 1999. This will complete a multimodal system which is executed for the long haul by an alternative either by waterway or by railroad.

4. The main projects in the northern part of Central Brazil are hydro-electric power stations on the Tocantins river and the transmission line completed in 1999, linking the hydro-power system of the North - including Tucuruí extension and installation of locks - with the system of the Centre-West region by a 1,300 km power grid connection of 500 kV. A series of hydro-electric plants equipped with locks is under construction or planned along the Tocantins river (KOHLHEPP 1998d), giving an additional 5,000 MW capacity for the regional development of the State of Tocantins, created in 1988 and turning into a new "El Dorado" of agrobusiness activities. Ongoing privatization of the electricity sector will offer the construction of new plants to private investments on long-term concessions.

As to the Araguaia-Tocantins waterway, with a dozen of waterway terminals, only the construction of the Santa Isabel channel and locks bypassing rapids are considered in the "Avança Brasil" budget. It must be emphasized that the construction work of the planned waterways Araguaia-Tocantins and Teles Pires-Tapajós had to be stopped by IBAMA because of high environmental risk, irregularities in the studies presented by the Ministry of Transport (CARVALHO 1999) and multiple failings in the environmental impact statement (FEARNSIDE 2001b). The official conflict with these projects was accompanied by extensive protests of affected indigenous groups. The North-South railroad from Imperatriz southwards is a US$ 1.5 billion project of doubtful value for transport strategies.

Perspectives

In view of the current regional infrastructural and economic activities, planned by the government in the "Avança Brasil" Programme and concerning the Amazon region, there is an extremely sharp contrast to the sustainability-based Pilot Programme concept of an environmentally sound use of the rain forest resources for the well-being of the

Amazonian population.

The terminology of the Ministry of Planning in "Avança Brasil" with "National axes of integration and development", "economic corridors" and a regional progress seen only in terms of economic growth reminds one of the military governments' approach of exploitation and valorization of the Amazonian periphery in the 1970s with the National Integration Programme (PIN).

With regard to the amount of planned investments, financed by two thirds from the government, and exceeding the financial framework of the Pilot Programme many times, it is of crucial importance to go ahead with very rigid measures of checking the environmental compatibility - in Brazil the environmental impact study (EIA) and the environmental impact statement (RIMA) - of the projects in preparation and monitoring ongoing projects in order to prevent wide-ranging negative consequences. This "Avança Brasil" Programme is an undertaking of conservative modernization, until now without any environmental component (BECKER 1999; NEPSTAD et al. 2000) or social relevance.

In times of "bottom-up" development efforts and decentralisation in all sectors, it is a very strange experience to accompany once more "top-down" strategies, absolutely not adjusted ecologically and to the basic needs of the regional population. There is a wide gap between planning ideology of the politically strong Ministry of Planning on the one hand and the Ministry of Environment on the other.

The regional development authority SUDAM never carried out self-determined or even participatory regional planning and development according to the endogenous regional potential. On the contrary, during military governments national goals of economic growth were put into effect in the sense of centre-oriented upgrading of Amazonia. Later on SUDAM became more and more depraved to an instrument of regional groups of interest. As already mentioned, since the 1980s SUDAM - like the other regional development authorities - lost a great deal of importance. In recent years, SUDAM was drowning by fraudulence and corruption, the case being investigated by the Federal Police (Veja, April 11, 2001). Even high ranking politicians are involved in the "rombo amazônico" of some billion reais. In May 2001 SUDAM was abolished and replaced by a new entity, the socalled ADA (Agência do Desenvolvimento da Amazônia), which hopefully will be strictly supervised.

The second PPA (Plano Plurianual de Investimentos) did not consider the necessities of the Amazon state governments, but the national logistic requirements with export corridors to intensify foreign trade with the northern hemisphere and with the Mercosul partners in South America.

G-7 countries at the same time are donors for an innovative environmental programme, linked with the protection of rain forests, and - at least European G-7 members and Japan - indirectly and directly stimulate soybean expansion on the northern pioneer front in Central Brazil, penetrating from *cerrado* areas into Amazon rain forest areas, supported by huge public and private financial investments in infrastructure and research. In the State of Pará soybean planting can be observed in the Paragominas and the Santarém areas, in the state of Amazonas near Humaitá. As the European market after the BSE crisis will need more fattening feed rich in protein, substituting animal waste feed, export of genetically still unchanged soybeans from Brazil will have another boom. The new "rei da soja" in Brazil, Blairo Maggi, is in a superior position being the largest private investor with the soybean export market as his direct lobby.

Soybean planters driven by global market forces are converting cleared land of small farmers expelled to new frontier areas to mechanized soybean cultivation. Because of massive infrastructure development needed to provide transportation for harvest and agrochemical inputs, the environmental impacts of soybean expansion are threatening tropical biodiversity (CARVALHO 1999; FEARNSIDE 2001b). Costs and benefits of soybean cultivation have to be clearly analyzed and the risk of falling prices because of South-American overproduction has to be taken into consideration.

In the "Avança Brasil" Programme the planning region Amazônia Legal is cut up in sub-regions. A new macro-zoning developed, which is formed by the current axes. It is obvious that cattle ranching, subsistence agriculture and logging activities will not remain concentrated on a strip of 50 km on both sides of the roads (NEPSTAD et al. 2000), but will cause wide-spread environmental impacts by deforestation and an increase in accidental fires.

In the southern and eastern part of Amazonia infrastructure, settlement systems, agricultural production and cattle ranching with large holdings prevail and there exists a conflicting situation for small-scale agriculture and *posseiros*. In those sub-regions of Amazônia Meridional and Oriental production dominates conservation and social measures are urgently needed (BECKER 1999).

In a new macro-zoning there will remain two core regions (Fig. 10):

1. *Amazônia Central*, mostly the State of Pará and the east of Amazonas, cut through by transport axes south of the Rio Amazonas and containing numerous indigenous lands and conservation units. This is a highly vulnerable region under very strong pressure, caused by the invading agrobusiness frontier from Amazônia Meridional and Oriental and "Avança Brasil" infrastructural projects. The aim for the future must be compatibility between production and conservation, the part of the sub-region north of the Rio Amazonas being reserved for conservation units.

2. *Amazônia Ocidental*, the huge region west of the central axis Rio Branco-Porto Velho-Manaus-Boa Vista, with a very low rate of deforestation up to now, should be destined for conservation issues (Fig. 10). Large indigenous territories, the creation of the so-called Central Ecological Corridor along the Rio Solimões, new conservation units, such as the "reserves of sustainable development" (BECKER 1999) should be protected against any "development" euphoria. This could be realized with the support of SIVAM, the military-based satellite monitoring programme of Amazonia, given the specific need of vigilance and control in view of increasing drug trafficking activities. No road construction and no large-scale project should be permitted in this region.

The traditional geopolitical vision of Amazonia as a vast empty space, reflected in regional planning of the past decades, has been a fundamental error. Today, the sustainability approach as the only acceptable alternative of future development (ANDERSON 1990; CLÜSENER-GODT & SACHS 1995; SCHNEIDER et al. 2000a; HALL 2000, among others) and the concept of productive conservation (HALL 1997) compete with the mostly destructive development ideology of large programmes in Amazonia.

Moreover, the proposal of the "bancada ruralista", representing the big landholders in the Brazilian Congress, to change the Forestry Code (Código Florestal), which still requires that private holdings in Amazonia maintain 80 % of their land in forest cover, is threatening Amazonian forests. In contrast to the CONAMA (Conselho Nacional de Amazônia) and the Brazilian Ministry of Environment, the *fazendeiros'* lobby is trying to reduce land use restrictions to a 20 % or at least 50 % rate of forest cover, opening

the Amazon region to a large-scale expansion of the agricultural frontier. As the decision of the Congress was postponed several times and the discussions continue, the struggle between the traditional exploitation model of regional development, based on the deforestation, and the new objective of sustainable use of forest resources is still prevailing.

As deforestation releases substantial amounts of greenhouse gases - the destruction of each hectare of forest causes a net release of nearly 200 metric tons of CO_2-equivalent carbon (FEARNSIDE 2001a) - carbon-offset funds to be paid to developing countries and discussed in the Kyoto Protocol could become an important mechanism for promoting forest conservation (LAURANCE et al. 2001; FEARNSIDE 1997, 2000, 2001a). The question of rain forests as sources of carbon sinks is still a point in controversy.

After three decades of regional planning in the Amazon rain forests, this region should no longer be treated as an experimental area for ecologically and socially inappropriate "development models" (KOHLHEPP 1989). Lessons learned during 30 years and since the start of the Pilot Programme should be primarily used by planning authorities to guarantee the requirements for a sustainable development.

Half a century ago, Harald Sioli was one of the first scientists who emphasized that Amazonia is "not the land of promise" (SIOLI 1951). During the following decades he analyzed the ecosystems of Amazonia and warned against deforestation and the ecological impacts of excessive economic exploitation (SIOLI 1973, 1984). The scientific community followed in his tracks, intensifying the interdisciplinary research on Amazonian issues.

Today, Amazonia is at the crossroads (HALL 2000) and hopefully the political decisions and the regional self-determination will support a sustainable resource management and gain major importance in improving the living conditions of all survival-oriented social groups as well as preventing a process of rapid ecological and socio-economic degradation for the benefit of the regional population and the preservation of Amazonia's rich biodiversity.

References

AMIGOS DA TERRA/Programa Amazônia (1997): Garimpagem Florestal. Relatório atualizado sobre extração ilegal de madeira na Amazônia Brasileira. - São Paulo: 80 pp.

ANDERSON, A.B. (ed.) (1990): Alternatives to deforestation: steps toward sustainable use of the Amazon rain forest. - Columbia Univ. Press, New York: 281 pp.

BECKER, B.K. (1995): Undoing myths: The Amazon – an urbanized forest. – In: CLÜSENER-GODT, M. & I. SACHS (eds.): Brazilian perspectives on sustainable development of the Amazon Region. Paris: 53-89.

BECKER, B.K. (1999): Cenários de curto prazo para o desenvolvimento da Amazônia. Cadernos do NAPIAm 6. - Ministério do Meio Ambiente/SCA, Brasília: 43 pp.

BECKER, B.K. (2001): Construindo a política brasileira de meio ambiente para a Amazônia: Atores, estratégias e práticas. - In: KOHLHEPP, G. (coord.): Brasil: Modernização e globalização. Bibliotheca Ibero-Americana 80. Frankfurt am Main, Madrid: 197-207.

BECKER, B.K. & C.A.G. EGLER (1992): Brazil: a new regional power in the world economy. - Cambridge Univ. Press, Cambridge: 205 pp.

BNDES (Banco Nacional de Desenvolvimento Econômico e Social) (1998): Programa Amazônia Integrada - PAI. - Rio de Janeiro.

BNDES (2000): Programa Brasil em ação. Estudo dos eixos nacionais de integração e desenvolvimento. - Relatório Síntese, 2 vol. Brasília: 493 pp.

BROWDER, J.O. & B.J. GODFREY (1997): Rainforest cities: Urbanization, development and globalization of the Brazilian Amazon. - Columbia Univ. Press, New York: 429 pp.

CARVALHO, R. (1999): A Amazônia rumo ao "ciclo da soja". – Amazonia. Papers, vol. **I**, 2. Amigos da Terra. Programa Amazônia. São Paulo: 8 pp.

CASTRO, E. & F. PINTON (org.) (1997): Faces do trópico úmido: conceitos e novas questões sobre desenvolvimento e meio ambiente. - UFPA/NAEA, Belém: 445 pp.

CHOMITZ, K.M. & T.S. THOMAS (2000): Geographic patterns of land use and land intensity in the Brazilian Amazon. - Development Research Group, World Bank, Washington, D.C.: 45 pp.

CLÜSENER-GODT, M. & I. SACHS (eds.) (1994): Extractivism in the Brazilian Amazon: Perspectives on regional development. (Man and the Biosphere Digest, 18). - UNESCO, Paris, The Parthenon Publ. Group, New York.

CLÜSENER-GODT, M. & I. SACHS (eds.) (1995): Brazilian perspectives on sustainable development of the Amazon Region. (Man and the Biosphere Series, 15). - UNESCO, Paris, The Parthenon Publ. Group, New York: 311 pp.

COTTON, C. & T. ROMINE (1999): Facing destruction. A Greenpeace briefing on the timber industry in the Brazilian Amazon. - Greenpeace International Publications, Amsterdam: 21 pp.

COY, M. (1988): Regionalentwicklung und regionale Entwicklungsplanung an der Peripherie in Amazonien. Probleme und Interessenkonflikte bei der Erschließung einer jungen Pionierfront am Beispiel des brasilianischen Bundesstaates Rondônia. - Tübinger Beiträge zur Geographischen Lateinamerika-Forschung **5**, Tübingen: 535 pp.

COY, M. (1992): Pioneer front and urban development. Social and economic differentiation of pioneer towns in Northern Mato Grosso (Brasil). – Applied Geography and Development **39**: 7-29.

FEARNSIDE, Ph.M. (1986): Human carrying capacity of the Brazilian rainforest. - Columbia Univ. Press, New York: 293 pp.

FEARNSIDE, Ph.M. (1993): Deforestation in Brazilian Amazonia: The effect of population and land tenure. – Ambio **22**(8): 537-545.

FEARNSIDE, Ph.M. (1997): Greenhouse gases from deforestation in Brazilian Amazonia: Net committed emissions. – Climatic Change **35**(3): 321-360.

FEARNSIDE, Ph.M. (1999a): Human carrying capacity estimation in Brazil's Amazonian settlements as a guide to development policy. – In: BILSBORROW, R.E. & D. HOGAN (eds.): Population and deforestation in the humid tropics. IUSSP, Liège: 122-137.

FEARNSIDE, Ph.M. (1999b): Combate ao desmatamento na Amazônia brasileira. Temas atuais. – Cad. Biodivers. **2**(2): 10-20.

FEARNSIDE, Ph.M. (2000): Deforestation impacts, environmental services and the international community. – In: HALL, A. (ed.): Amazonia at the crossroads: the challenge of sustainable development. University of London Press, London: 11-24.

FEARNSIDE, Ph.M. (2001a): Effects of land use and forest management on the carbon cycle in the Brazilian Amazon. - Journal of Sustainable Forestry **12**(1/2): 79-97.

FEARNSIDE, Ph.M. (2001b): Soybean cultivation as a threat to the environment in Brazil. - Environmental Conservation **28**(1): 23-38.

GOODLAND, R.J.A. & H.S. IRWIN (1975): Amazon jungle. Green hell to red desert? An ecological discussion of the environmental impact of the highway construction program in the Amazon Basin. - Elsevier Scientific Publishing Company, Oxford, New York, Amsterdam: 155 pp.

GOODMAN, D. & A. HALL (eds.) (1990): The future of Amazonia: Destruction or sustainable development. - St. Martins Press, New York: 419 pp.

GREENPEACE (ed.) (1997): Logging the planet. Asian companies marching across our last forest frontiers. - Greenpeace International, Asian Companies Report: 54 pp.

HALL, A. (1989): Developing Amazonia: Deforestation and social conflicts in Brazil's Carajás programme. - Manchester Univ. Press, Manchester: 303 pp.

HALL, A. (1997): Sustaining Amazonia: Grassroots action for productive conservation. - Manchester Univ. Press, Manchester: 269 pp.

HALL, A. (ed.) (2000): Amazonia at the crossroads: the challenge of sustainable development. - University of London Press, London: 257 pp.

HARTMANN, G. (ed.): Amazonien im Umbruch. Aktuelle Probleme und deutsche Forschungen im größten Regenwaldgebiet der Erde. - Dietrich Reimer, Berlin: 389 pp.

IAG (International Advisory Group) (2000): Land issues and the G7 Pilot Programme to conserve the Brazilian rain forest. – IAG 14th report, part II. Brasília: 11pp.

IAG (2001): Brazilian conservation policies and the Pilot Programme to conserve the Brazilian rain forest. - IAG 15th report, part II. Brasília: 14 pp.

INPE (Instituto Nacional de Pesquisas Espaciais) (1998): Amazonia – Deforestation 1995-1997. - FUNCATE, São José dos Campos: 23 pp.

INPE (2000): Monitoramento da floresta amazônica brasileira por satélite 1998-1999. - FUNCATE, São José dos Campos: 22 pp.

IPAM (Instituto de Pesquisa Ambiental da Amazônia) et al. (1998): Risque 98. - Mapa de risco de incêndios florestais e queimadas agrícolas na Amazônia Brasileira para o segundo semestre de 1998: 27 pp.

JUNK, W.J. (1989): The use of Amazonian floodplains under an ecological perspective. – Interciencia **14** (6): 317-322.

JUNK, W.J., OHLY, J.J., PIEDADE, M.T.F. & M.G.M. SOARES (2000): The Central Amazon floodplain: Actual use and options for a sustainable management. - Backhuys Publ., Leiden: 584 pp.

KASBURG, C. & M.M. GRAMKOW (org.) (1999): Demarcando terras indígenas; experiências e desafios de um projeto de parceria. - FUNAI, PPTAL, GTZ, Brasília: 312 pp.

KOHLHEPP, G. (1976a): Stand und Problematik der brasilianischen Entwicklungsplanung in Amazonien. - Amazoniana **6**(1): 87-104.

KOHLHEPP, G. (1976b): Planung und heutige Situation staatlicher kleinbäuerlicher Kolonisationsprojekte an der Transamazônica. – Geographische Zeitschrift **64**(3): 171-211.

KOHLHEPP, G. (1978): Erschließung und wirtschaftliche Inwertsetzung Amazoniens. Entwicklungsstrategien brasilianischer Planungspolitik und privater Unternehmen. – Geographische Rundschau **30** (1): 2-13.

KOHLHEPP, G. (1979): Brasiliens problematische Antithese zur Agrarreform: Agrarkolonisation in Amazonien. Evaluierung wirtschafts- und sozialgeographischer Prozeßabläufe an der Peripherie im Lichte wechselnder agrarpolitischer Strategien. - In: ELSENHANS, H. (ed.): Agrarreform in der Dritten Welt. Campus, Frankfurt am Main, New York: 471-504.

KOHLHEPP, G. (1983): Strategien zur Raumerschließung und Regionalentwicklung im Amazonasgebiet. Zur Analyse ihrer entwicklungspolitischen Auswirkungen. - In: BUISSON, I. & M. MOLS (eds.): Entwicklungsstrategien in Lateinamerika in Vergangenheit und Gegenwart. Internationale Gegenwart 5. Ferdinand Schöningh, Paderborn et al.: 175-193.

KOHLHEPP, G. (1984): Development planning and practices of economic exploitation in Amazonia. Recent trends in spatial organization of a tropical frontier region in Brazil (1966-1981). - In: SIOLI, H. (ed.): The Amazon. Limnology and landscape ecology of a mighty tropical river and its basin. Monographiae Biologicae 56. W. Junk Publ., Dordrecht: 649-674.

KOHLHEPP, G. (1987a): Amazonien. Regionalentwicklung im Spannungsfeld ökonomischer Interessen sowie sozialer und ökologischer Notwendigkeiten. Problemräume der Welt 8. - Aulis & Deubner, Köln: 68 pp.

KOHLHEPP, G. (1987b): Problemas do planejamento regional e do desenvolvimento regional na área do Programa Grande Carajás no Leste da Amazônia. - In: KOHLHEPP, G. & A. SCHRADER (eds.): Homem e natureza na Amazônia. Tübinger Beiträge zur Geographischen Lateinamerikaforschung **3**: 313-345.

KOHLHEPP, G. (1989): A challenge to science and regional development policy. Reflections on the future development of Amazonia. – Applied Geography and Development **33**: 52-67.

KOHLHEPP, G. (1991a): Impactos regionais de "grandes projetos" e as possibilidades de reorganização do espaço na periferia amazônica. – In: ARAGON, L.E. (ed.): A desordem ecológica na Amazônia. Série Cooperação Amazônica 7. UNAMAZ, UFPAM, Belém: 253-269.

KOHLHEPP, G. (1991b): The destruction of the tropical rain forests in the Amazon region of Brazil. An analysis of the causes and the current situation. – Applied Geography and Development **38**: 87-109.

KOHLHEPP, G. (1995): The International Pilot Programme for Amazonia: An approach to sustainable regional development. – International Geographical Union, Bulletin **45**: 17-30.

KOHLHEPP, G. (1997): Regional policies in Brazil: the spatial impact of state activity in Amazonia. – In: VAN NAERSSEN, T. et al. (eds.): The diversity of development. Essays in honour of Jan Kleinpenning. Van Gorcum, Assen/NL: 231-240.

KOHLHEPP, G. (1998a): O problema do espaço vital dos povos indígenas e os conflitos de interesse na demarcação das Áreas Indígenas na Amazônia Brasileira. – In: KÖNIG, H.-J. (ed.): El indio como sujeto y objeto de la historia latinoamericana. Pasado y presente. (= Americana eystettensia. Serie A: Kongreßakten 18). - Vervuert, Frankfurt am Main, Madrid: 109-120.

KOHLHEPP, G. (1998b): Tropenwalderhaltung in Brasilien. Umweltpolitische Strategien zum Schutz und zur nachhaltigen Nutzung der Regenwälder. – In: Lateinamerika-Jahrbuch 1998. Vervuert, Frankfurt am Main: 9–34.

KOHLHEPP, G. (1998c): Das Internationale Pilotprogramm zum Schutz der tropischen Regenwälder Brasiliens. Globale, nationale, regionale und lokale Akteure auf dem Weg zu einer Strategie der nachhaltigen Entwicklung? – In: KOHLHEPP, G. & M. COY (eds.): Mensch-Umwelt-Beziehungen und nachhaltige Entwicklung in der Dritten Welt. Tübinger Beiträge zur Geographischen Lateinamerikaforschung **15**: 51–86.

KOHLHEPP, G. (1998d): Grandes projetos de barragem no Brasil: problemas ecológicos e sócio-econômicos. – Revista de Estudos Ambientais **1**(1): 50-61.

KOHLHEPP, G. (coord.) (2001): Brasil: Modernização e globalização. Bibliotheca Ibero-Americana 80. - Vervuert, Frankfurt am Main, Madrid: 276 pp.

KOHLHEPP, G. & M. COY (1986): Conflicts of interests and regional development planning in colonizing the Brazilian Amazon: The case of Rondônia. – In: KLEINPENNING, J.M.G. (ed.): Competition for rural and urban space in Latin America. Its consequences for low income groups. Nederlandse Geografische Studies **25**. Amsterdam, Nijmegen: 61-75.

KOHLHEPP, G. & A. SCHRADER (eds.) (1987): Homem e natureza na Amazônia. Hombre y Naturaleza en la Amazonia. - Tübinger Beiträge zur Geographischen Lateinamerikaforschung **3**: 507 pp.

KOHLHEPP, G. & M. COY (eds.) (1998): Mensch-Umwelt-Beziehungen und nachhaltige Entwicklung in der Dritten Welt. - Tübinger Beiträge zur Geographischen Lateinamerikaforschung **15**: 465 pp.

KOHLHEPP, G. & M. BLUMENSCHEIN (2000): Brasileiros sulistas como atores de transformação rural no Centro-Oeste brasileiro: O caso de Mato Grosso. – Território **8**: 47-66.

KOLK, A. (1998): From conflict to cooperation: International policies to protect the Brazilian Amazon. – World Development **26**(8): 1481-1493.

LAURANCE, W.F. et al. (2001): The future of the Brazilian Amazon. - Science **291**: 438-439 (Supplementary material 11 pp.).

LELE, U. et al. (1999): Florestas em perigo: Desafios da conservação com desenvolvimento. Uma avaliação do desenvolvimento florestal e da assistência do Banco Mundial no Brasil. - Banco Mundial, Brasília: 145 pp.

LEROY, J.-P. & Th.W. FATHEUER (org.) (1996): Certificação florestal. - Série: Cadernos de Proposta ano 3, nº 4. FASE/Sactes/DED, Rio de Janeiro: 52 pp.

MACHADO, L.O. (1996): O comércio ilícito de drogas e a geografia da integração financeira: uma simbiose? - In: CASTRO, I. et al. (org.): Brasil. Questões atuais da reorganização do território. Bertrand Brasil, Rio de Janeiro: 15-64.

MAHAR, D.J. (1988): Government policies and deforestation in Brazil's Amazon Region. -World Bank, Washington, D.C.

MAHAR, D.J. (2000): Land-use zoning in the Amazon Region: The experience of Rondônia, Acre and Tocantins (mimeo): 35 pp.

MAHAR, D.J. & C.E.H. DUCROT (1998): Land-use zoning on tropical frontiers: Emerging lessons from the Brazilian Amazon. - The World Bank, EDI Case Studies, Washington, D.C.: 25 pp.

MEGGERS, B.J. (1994): Archeological evidence for the impact of Mega-Niño events of Amazonia during the past two millenia. – Climate Change **28**: 321-338.

MMA (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal)/ WORLD BANK (1998): Pilot Program to conserve the Brazilian rain forest. Brasília: 36 pp.

MMA/CONAMAZ (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal/Conselho Nacional da Amazônia Legal) (1998): Síntese das ações para a implementação da política nacional integrada para a Amazônia Legal. Período de 1995 a 1997. Brasília: 95 pp.

MMA/SCA (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal / Secretaria de Coordenação da Amazônia) (1995): Política nacional integrada para a Amazônia Legal. - CONAMAZ, Brasília: 34 pp.

MMA (Ministério do Meio Ambiente) (ed.) (2001): Causas e dinâmica do desmatamento na Amazônia. - MMA, Brasília: 436 pp.

MORAN, E.F. (1981): Developing the Amazon: The social and ecological consequences of government - directed colonization along Brazil's Transamazon Highway. - Indiana Univ. Press, Bloomington: 292 pp.

MORAN, E.F. (1990): A ecologia humana das populações da Amazônia. - Vozes, Petrópolis: 367 pp.

MPBM (Ministry of Planning, Budget and Management) (1999): Avança Brasil. Development structures for investment. Brasília: 22 pp.

MPOG (Ministério do Planejamento, Orçamento e Gestão) (2000): Brasil em ação. - Relatório Final 1996-1999. Brasília: 143 pp.

NEPSTAD, D.C. et al. (1999): Large-scale impoverishment of Amazon forests by logging and fire. - Nature **398**: 505-508.

NEPSTAD, D.C. et al. (2000): Avança Brasil: os custos ambientais para a Amazônia. - Editora Alves, Belém: 24 pp.

NEPSTAD, D.C., MOREIRA, A.G. & A.A. ALENCAR (1999): Flames in the rain forest: Origins, impacts and alternatives to Amazonian fires. - World Bank, MMA/SCA, Brasília: 161 pp.

NOBRE, C.A. et al. (1991): Amazonian deforestation and regional climate change. – Journal of Climate **4**: 957-988.

PASCA,D. (1998): Nachhaltige Ressourcennutzung versus nachhaltiger Verlust von Ressourcen: Die Rückzugsräume der Indianer in Mato Grosso, Brasilien. - In: KOHLHEPP, G. & M. COY (eds.): Mensch-Umweltbeziehungen und nachhaltige Entwicklung in der Dritten Welt. Tübinger Beiträge zur Geographischen Lateinamerika-Forschung **15**: 167-194.

POSEY, D.A. (2000): Biodiversity, genetic resources and indigenous peoples in Amazonia: (Re)discovering the wealth of traditional resources of native Amazonians. - In: HALL, A. (ed.): Amazonia at the crossroads. London: 188-204.

PRESIDÊNCIA DA REPÚBLICA (1996): Brasil em ação. Investimentos para o desenvolvimento. - Ministério do Planejamento e Orçamento, Brasília: 82 pp.

SCHNEIDER, R.R. (1994): Government and the economy on the Amazon frontier. - World Bank, Washington, D.C.

SCHNEIDER, R.R., ARIMA, E., VERÍSSIMO, A., BARRETO, P. & C. SOUZA JR. (2000a): Amazônia sustentável: limitantes e oportunidades para o desenvolvimento rural. - Série Parcerias 1. World Bank, IMAZON, Belém: 57 pp.

SCHNEIDER, R.R., VERÍSSIMO, A., ARIMA, E. & A. BARRETO (2000b): Sustainable forestry and the changing economics of land: The implications for public policy in the Amazon. - World Bank, Brasília.

SIOLI, H. (1951): Amazonien – Land der Verheißung? – Südamerika **2**: 57-63.

SIOLI, H. (1956): Über Natur und Mensch im brasilianischen Amazonasgebiet. – Erdkunde **10**(2): 89-109.

SIOLI, H. (1968): Zur Ökologie des Amazonasgebietes. – In: FITTKAU, E.J. et al. (eds.): Biogeography and Ecology in South America. W. Junk Publ., The Hague: 137-170.

SIOLI, H. (1969): Entwicklung und Aussichten der Landwirtschaft im brasilianischen Amazonasgebiet. – Die Erde **100**(2-4): 307-326.

SIOLI, H. (1973): Recent human activities in the Brazilian Amazon Region and their ecological effects. - In: MEGGERS, B.J., E.S. AYENSU & W.D. DUCKWORTH (eds.): Tropical forest ecosystems in Africa and South America: A comparative review. - Smithsonian Institution Press, Washington: 321-334.

SIOLI, H. (1983): Amazonien: Grundlagen der Ökologie des größten tropischen Waldlandes. - Wiss. Verlagsgesellschaft, Stuttgart: 64 pp.

SIOLI, H. (ed.) (1984): The Amazon. Limnology and landscape ecology of a mighty tropical river and its basin. Monographiae Biologicae **56**. Junk Publ., Dordrecht: 763 pp.

SKOLE, D. & C. TUCKER (1993): Tropical deforestation and habitat fragmentation in the Amazon: Satellite data from 1978 to 1988. – Science **260**: 1905-1910.

SMERALDI, R. & A. VERÍSSIMO (1999): Hitting the target: Timber consumption in the Brazilian domestic market and promotion of forest certification. - Amigos da Terra/IMAFLORA/IMAZON, São Paulo: 41 pp.

SMITH, N.J.H. (1982): Rainforest corridors: The Transamazon colonization scheme. - Univ. of California Press, Berkeley: 248 pp.

SMITH, N.J.H., SERRÃO, E.A.S., ALVIM, P.T. & I.C. FALESI (1995): Amazonia: Resiliency and dynamism of the land and its people. - United Nations Univ. Press, Tokyo: 253 pp.

SMITH, N.J.H., DUBOIS, J., CURRENT, D., LUTZ, E. & C. CLEMÉNT (1998): Agroforestry experiences in the Brazilian Amazon: Constraints and opportunities. - World Bank, Brasília: 67 pp.

SOUZA, H.M. DE (2001): Gastos publicos do governo federal na Amazônia Legal: defesa, desenvolvimento e meio ambiente. - Instituto de Estudos Socioeconômicos. Nota técnica nº 044. Brasília: 7 p.

STERNBERG, H. O'REILLY (1998): A água e o homem na várzea do Careiro. - Museu Paraense Emílio Goeldi, Belém (2nd ed., 2 vols.): 330 pp.

THÉRY, H. (1997): Configurações territoriais na Amazônia. - Paris.

UNAMAZ/SCA (coord.) (1998): Amazônia 21: Uma agenda para um mundo sustentável. - DMF Congressos, Brasília: 253 pp.

VALVERDE, O. (1989): Grande Carajás: Planejamento de destruição. - Editora Forense UNB/USP, São Paulo, Rio de Janeiro, Brasília.

VERÍSSIMO, A., SOUZA JR, C., STONE, S. & C. UHL (1998): Zoning of timber extraction in the Brazilian Amazon: A test case using Pará State. - Conservation Biology **12**(1): 128-136.

WILHELMY, H. (1970): Amazonien als Lebens- und Wirtschaftsraum. – In: Deutsche Geographische Forschung in der Welt von heute. Ferdinand Hirt, Kiel: 69-85.

WORLD BANK (1994): Pilot Program to conserve the Brazilian rain forests. Background and issues. - Washington, D.C. (mimeo).

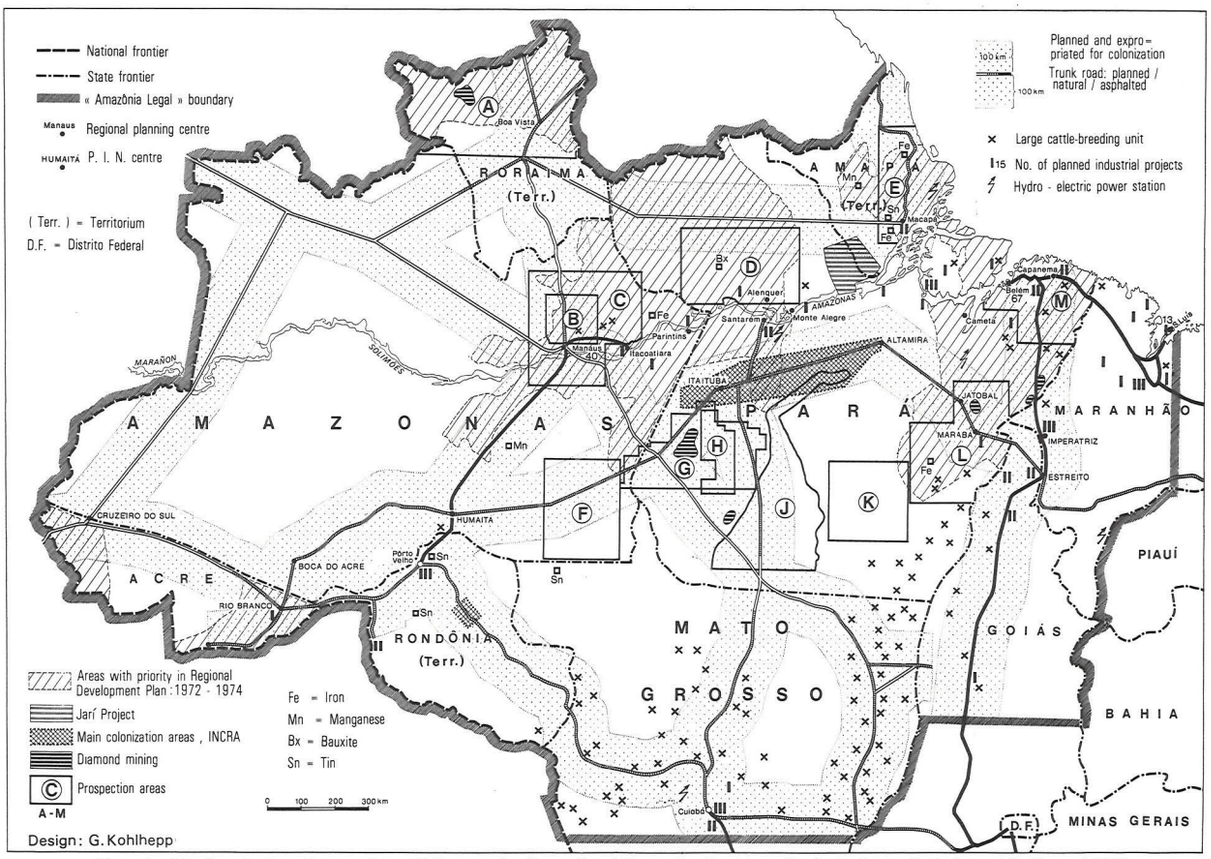


Fig. 1: Regional planning and spatial organization of public and private projects in Amazônia Legal in the mid 70s
(Source: KOHLHEPP 1976, map 2)

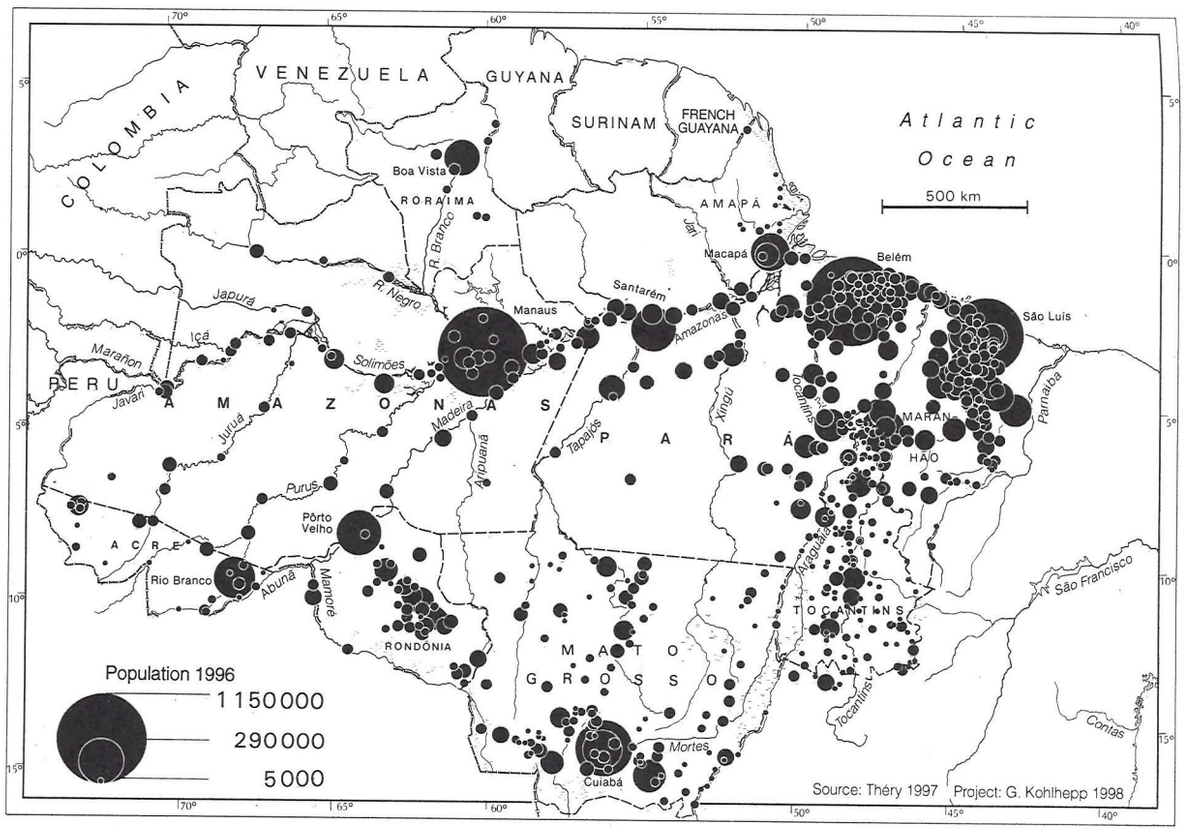


Fig. 2: Population in the Brazilian Amazon Region (without indigenous population)
(from: KOHLHEPP 1998c)

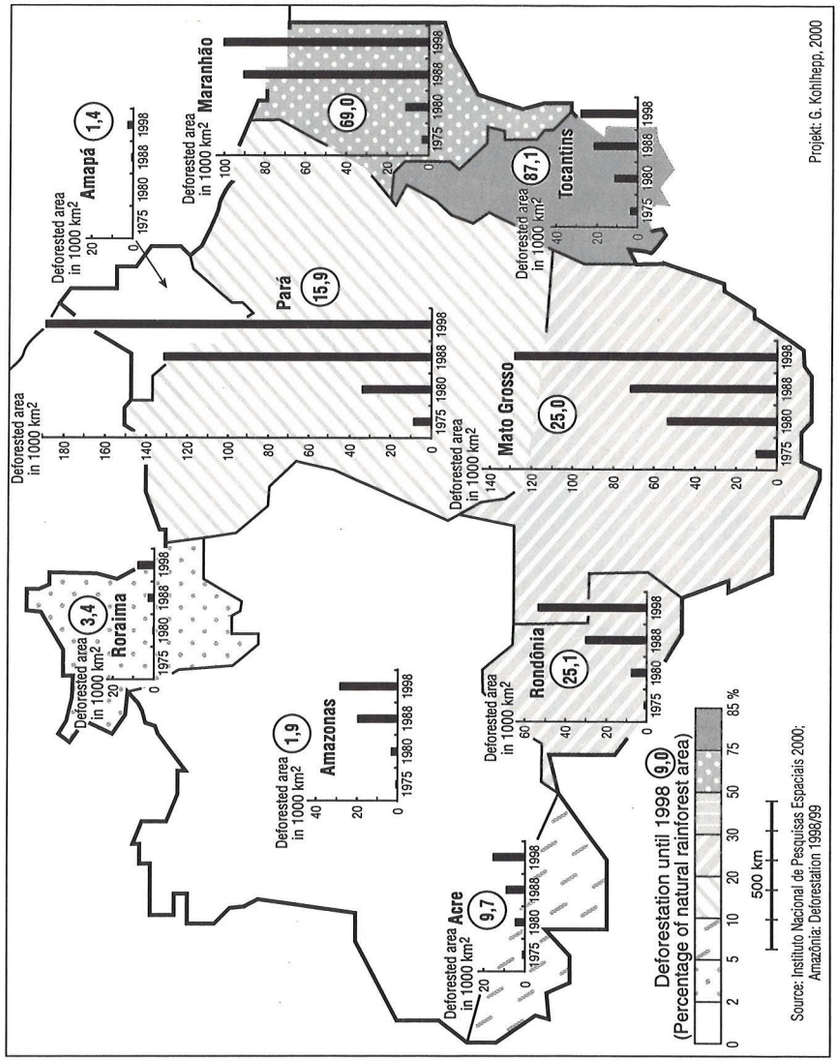


Fig. 3: Deforestation in the Brazilian Amazon Region 1975 – 1998

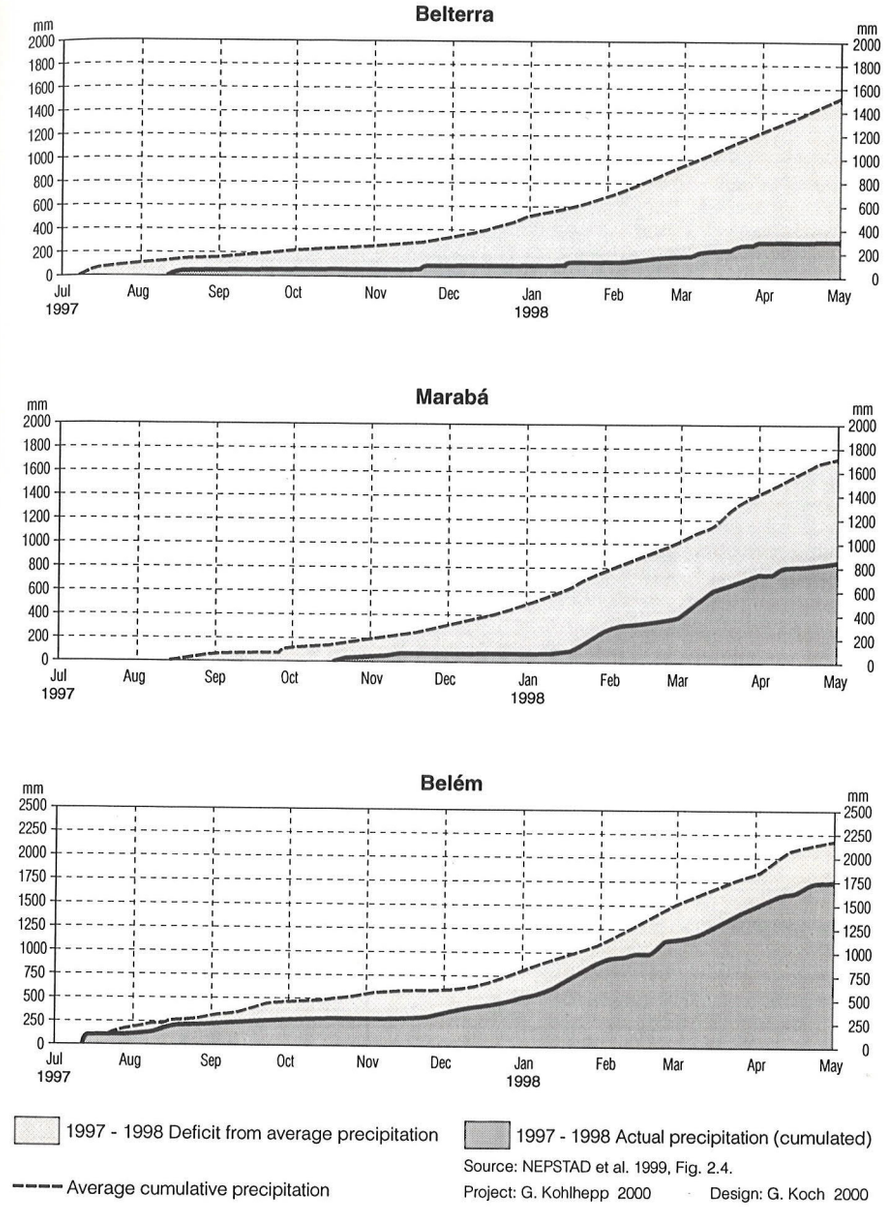


Fig. 4: Rainfall reduction during El Niño events

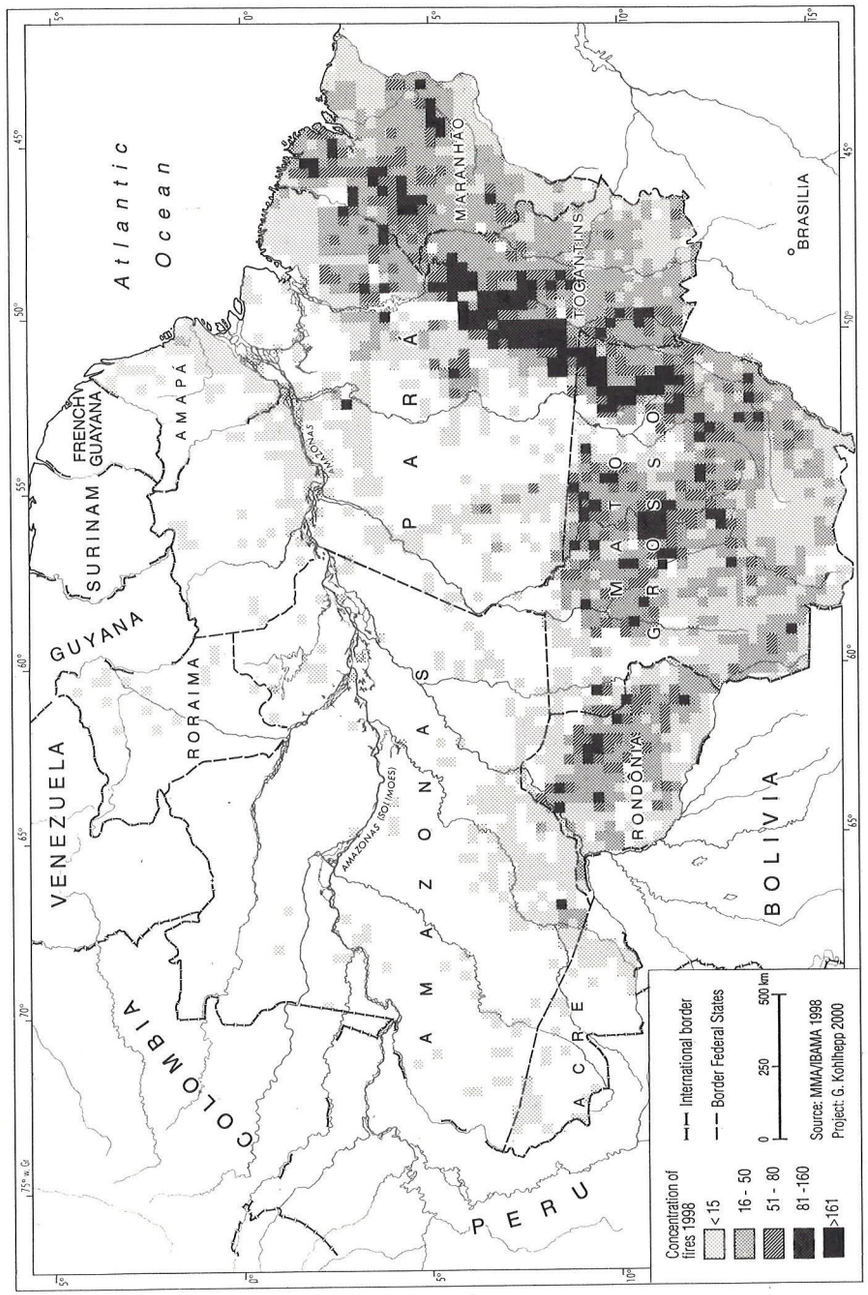
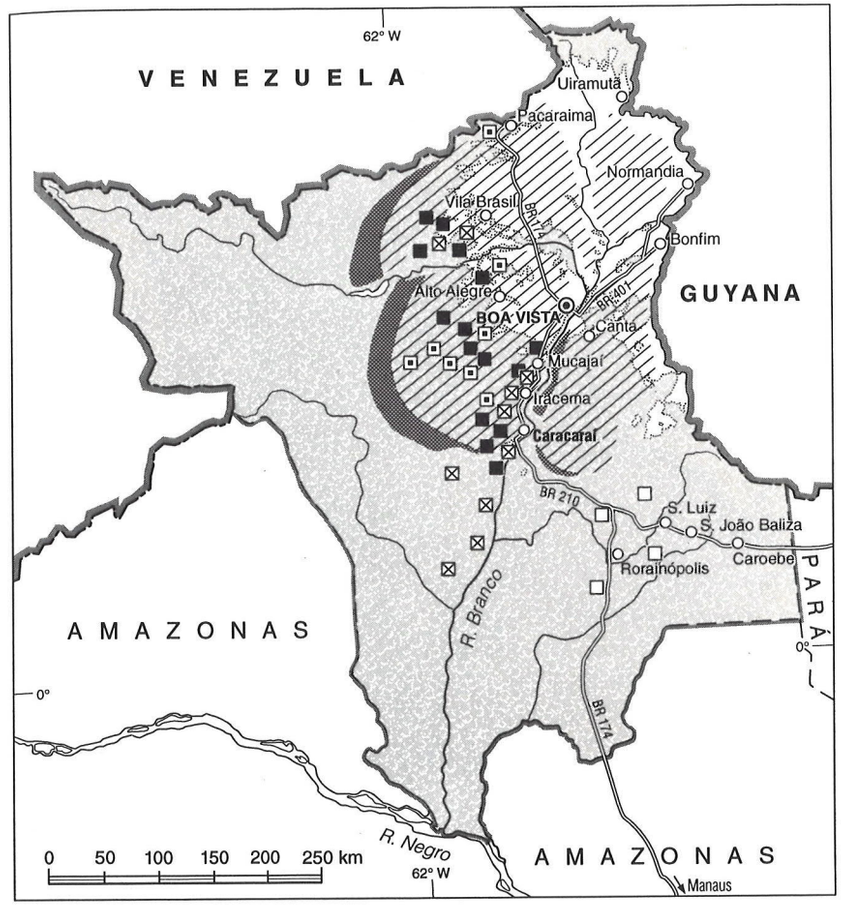


Fig. 5: Areas of concentration of fires in 1998



Source: Estado de Roraima / SEPLAN 1998

Project: G. Kohlhepp 1998

- Fire frontline at the end of March 1998
- Area of fires
- Centres of fires January 1998
- Centres of fires February 1998
- Fires on 20.3.1998
- Fires on 25.3.1998
- International border
- Border of the State of Roraima
- Major road
- Capital of Roraima
- Municipality
- Tropical rain forest
- Campos cerrados

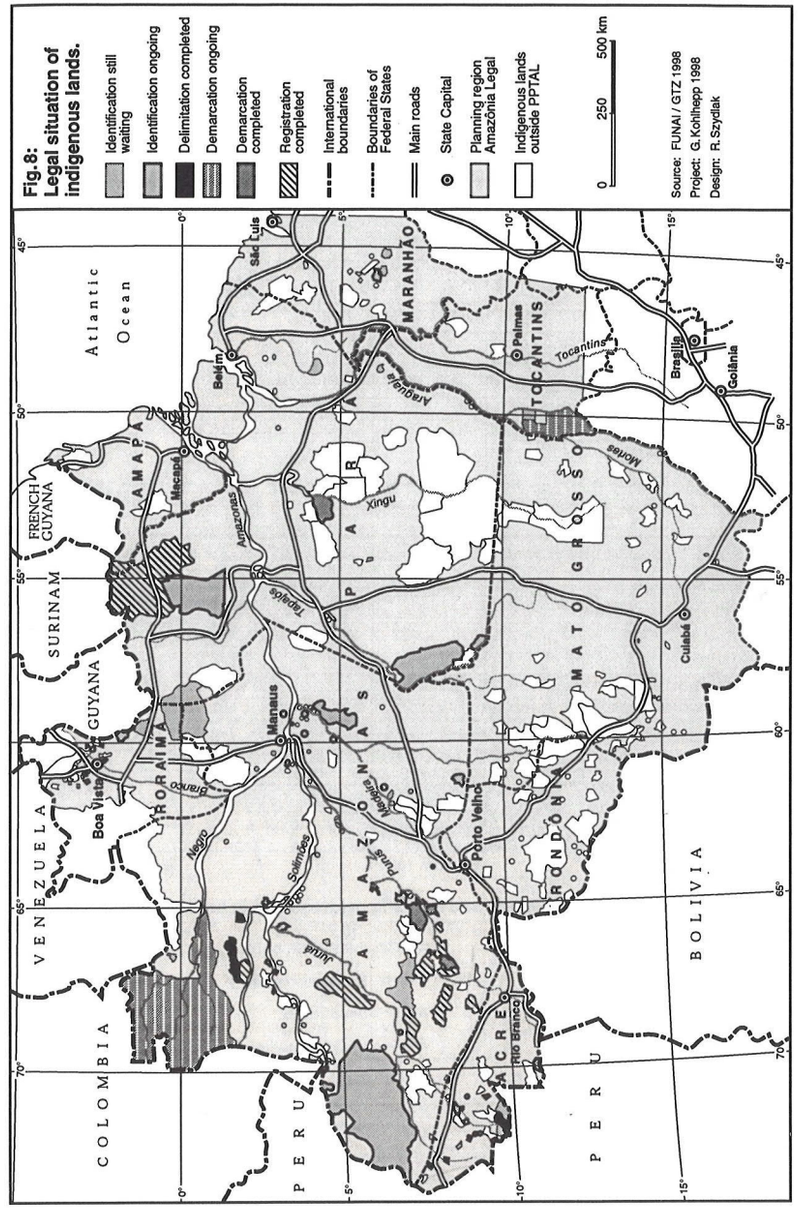
Fig. 6: Fires in the State of Roraima (Northern Amazonia) (from: KOHLHEPP 1998c)

Source: Estado de Roraima, SEPLAN / DEMA 1999

Project: G. Kohlhepp 2000

- Area with jurisdiction of the State of Roraima
- Conservation area of IBAMA (National Park, Ecological Station)
- Indigenous reservation
- Military area
- Flooded area
- Mountainous region

Fig. 7: Jurisdiction over the State of Roraima



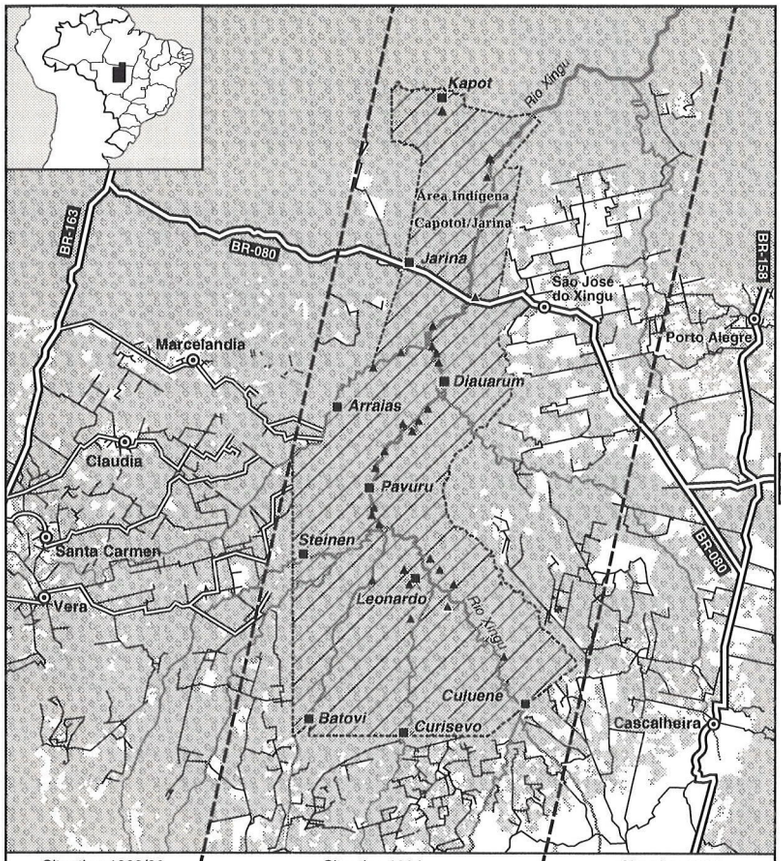


Fig.9: Parque Indígena do Xingu and ongoing deforestation in the surroundings

- Tropical rainforest and Cerradão
- Parque Indígena do Xingu (National Park)
- Posto Indígena
- Indigenous settlement
- Deforestation (until 1993/1994)
- Settlement
- Federal roads (BR-)
- Exploitation roads
- Small roads
- Limit of Sattelite image

Source: Instituto Socioambiental 1995
Project: G.Kohlhepp
Design: R.Szydlak

0 25 50 75 100 km

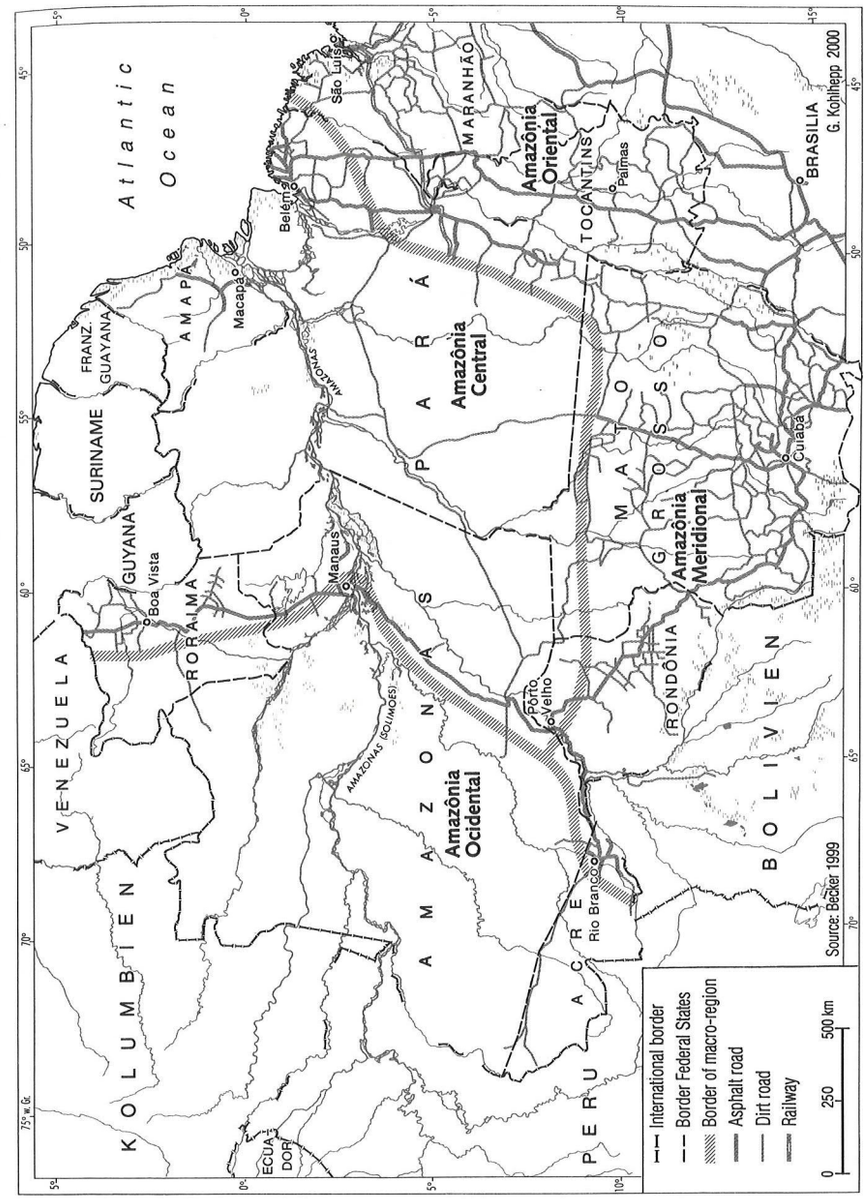


Fig. 10: Amazônia Legal. Scheme of the new macro-zoning